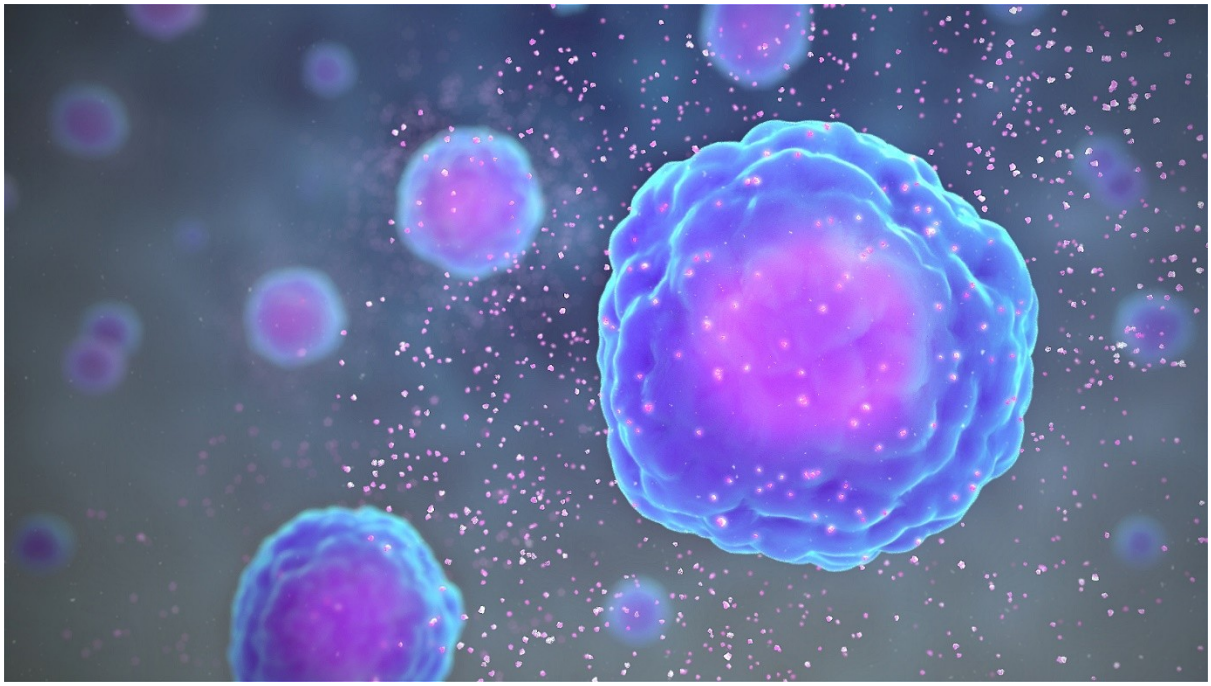
Cytokines

Finally in this lesson, you will look at the alarm bells of the innate immune system – the cytokines.

Cytokines are chemical communicators which synchronise immune responses by affecting cell differentiation, proliferation and gene expression. Their release is initiated by the binding of PRRs and PAMPs which alerts the system that a threat is present and requires elimination together with any infected cells.



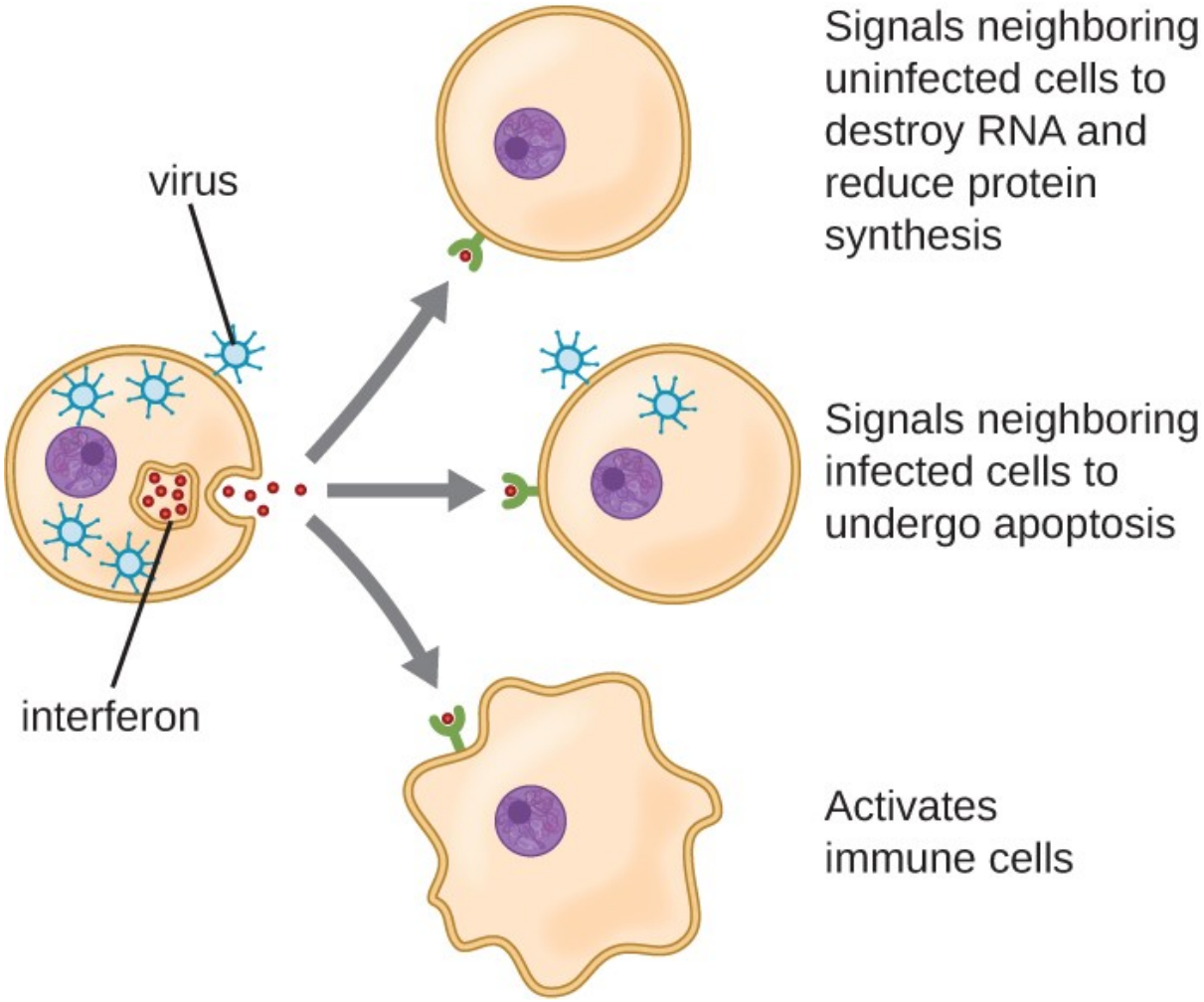
Small cytokine proteins represented by tiny pink circles are released extracellularly in large quantities by one cell, represented in purple-blue colour. Once in the extracellular milieu, cytokines can act on the surrounding cells also represented here in purple-blue colour.

Source: "Cytokine Release". www.scientificanimations.com - http://www.scientificanimations.com/wiki-images/, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=77708936.

There are over 40 types of cytokines produced by different cells and of varied immunomodulatory capabilities. There are also different subclasses of cytokines which perform different functions.

1. **Interleukins (ILs)** are one subclass of cytokines which, as the name suggests, mediate communication between leukocytes (white blood cells) and other body cells. They facilitate the dialogue between the innate and adaptive immunity upon release after PAMP recognition during inflammatory and immune responses.

2. **Interferons** are another class of early-acting cytokines generated by various cells in the inflammatory response to infections, particularly conferring resistance to viral threats. They promote innate and adaptive immune responses and are involved in regulating normal and tumour cell survival and death.

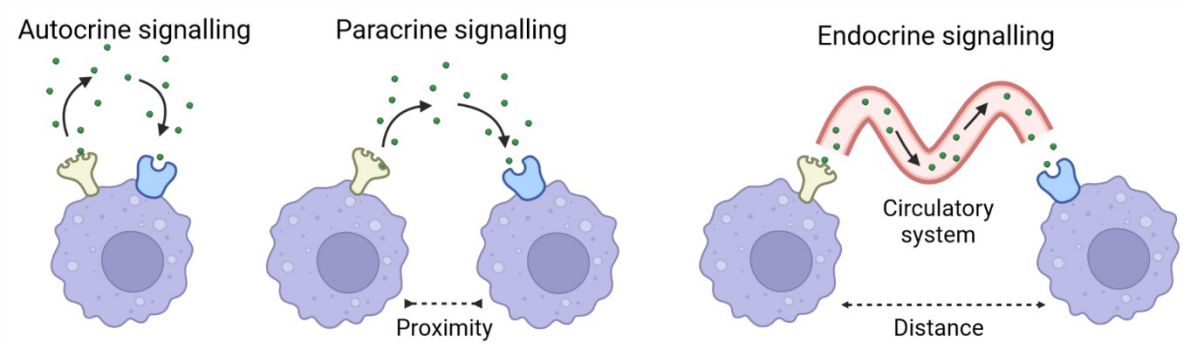

virus
interferon
Signals neighboring uninfected cells to destroy RNA and reduce protein synthesis
Signals neighboring infected cells to undergo apoptosis
Activates immune cells

The cell on the left has both intra and extracellular viruses present. Interferon molecules are being produced within the cell and then released through the cell lining. Three neighbouring cells are shown on the right. With the first, uninfected cell at the top, interferons signal to the cell to destroy RNA and reduce protein sythesis. To the second, infected cell in the middle, interferon has signalled to undergo apoptosis (programmed cell death). The third cell, at the bottom, is an immune cell which has been activated by interferon. These responses help fight the infection.

Source: "Interferons" by Mary Ann Clark, Matthew Douglas, Jung Choi (2018) Biology 2e. OpenStax. CC BY 4.0. Access for free at https://openstax.org/books/biology-2e/pages/1-introduction.

Acting modes

Cytokines signal through binding to their specific receptor expressed on the surface of a target cell which induces intracellular cascade leading to a biological effect. Cytokines can act on same cell (**autocrine**), adjacent cell (**paracrine**) or occasionally on distant cell (**endocrine**) to stimulate molecular changes.



3 acting modes of cytokines shown with the release of cytokines from 3 cells. In autocrine action, the first cell releases cytokines which are recognised by their receptors on the same cell. In paracrine action, the second cell releases cytokines which are recognised by their corresponding receptor on a nearby cell. In endocrine action, the third cell releases cytokines into the circulatory system and these cytokines are recognised by their corresponding receptor on a distant cell.